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אני, (שם המבקש, מענו ולגבי גוף מאוגד - מקום התאגדותו)
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בעל אמצאה מכח הדין Operation of Law ששמה הוא
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(בעברית) (Hebrew)
מערכת משולבת לנקוי אבנית ולהכחדת הבקטריה Legionella Pneumophila במערכות אספקת מים

(באנגלית) (English)
A COMBINED ELECTROCHEMICAL SYSTEM FOR SCALE TREATMENT AND ERADICATING LEGIONELLA PNEUMOPHILA BACTERIA IN WATER SUPPLY SYSTEMS

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• בקשת חלוקה - Application of Division	• בקשת פטנט מוסף - Application for Patent Addition	• דרישת דין קדימה Priority Claim		
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מחק את המיותר Delete whatever is inapplicable

מערכת משולבת לניקוי אבנית ולהכחדת הבקטריה *Legionella Pneumophila*

במערכות אספקת מים

A combined electrochemical system for scale treatment and eradicating *Legionella Pneumophila* bacteria in water supply systems

A combined electrochemical system for scale treatment and eradicating *Legionella Pneumophila* bacteria in water supply systems

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to scale treatment and eradicating bacteria in water supply systems, and, in particular, to an efficient treatment of scale and eradicating bacteria in water systems, in general, and *Legionella Pneumophila,* in particular.

Various systems for preventing scale crystallization and precipitation, in hot and cold water systems, have been installed in or outside the systems. Substantially, these systems prevent the crystallization and precipitation of scale by leaving the scale substances as suspended colloids.

For generations, many scale systems and devices have been invented and used by those skilled in the art. Among these systems are the modern and efficient systems based on the "Guldager" electrolytic method.

In these systems, aluminum anodes, connected to an external electrical supply source, are immersed in metallic water tanks. The anodes oxidize by the water, while the water becomes alkaline with high pH values close to the tanks' wall. As a result, calcium carbonate - $CaCO_3$ precipitate and the aluminum anodes dissolve in the water as aluminum hydroxide - $Al(OH)_3$.

Substantially, these prior art systems prevent to some extent the crystallization of scale leaving the precipitate as suspended colloids and coagulants without disposing of these colloids.

A more modern prior art system, described in Israeli Patent No.120003 to Elgressy, is a modified "Gulager" system but with non dissolving electrodes made of, or coated with, Ti/NiO. This system, which will be described latter in details as part of the present invention, disposes of the scale colloids.

It is also known that water may contain many kinds of bacteria that can be dangerous to animals and human beings. Especially dangerous is *Legionella Pneumophila* that can be fatal and cause painful death to adults, to smoking and alcoholic people, and to patients that suffer from problems in the immune system, such as patients having steroids prescriptions, patients after transplanting of organs, AIDS patients etc.

Therefore, drinking water must be disinfected against harmful bacteria, in general, and *Legionella Pneumophila, in* particular.

Water disinfection, according to the teaching of the prior art, includes treatment of the water with sodium hypochlorite (NaClO). Since sodium hypochlorite above the concentration of 0.5 ppm is toxic and harmful to human beings, water disinfection with this substance is prohibited in systems of drinking water. Occasional warming of water to 70°C is also regarded as another alternative treatment against the *Legionella Pneumophila* bacteria. However, the *Legionella Pneumophila* bacteria undergoes various mutations in high temperatures that makes the bacteria immune to high temperatures. Additionally, at these temperatures metal systems suffer from increased corrosion, which is particularly high in galvanized systems.

There is no single combined treatment, in prior art, for controlling scale

and disinfecting water from bacteria, including *Legionella Pneumophila.*

There is therefore a recognized need for, and it would be highly advantageous to have a method of, and a system for treating water electrochemically, and disinfecting it from bacteria, in general, and of Legionella *Pneumophila,* in particular.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a combined electrochemical system for, and a method of, scale treatment and water disinfection.

The principles and operation of the system and method according to the present invention may be better understood with reference to the drawing and the accompanying description.

Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawing. The invention is capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

Referring now to the drawing, FIG. 1 is a schematic cross sectional view of a combined electrochemical system for scale treatment and eradicating *Legionella Pneumophila* bacteria in water supply systems.

The combined electrochemical system includes two electrical cells: a coagulating cell and a scale treatment cell.

The coagulating cell consists of a metallic column or tank, and an anode, made of various alloys of aluminum, inserted in the column. Typically, the anode consists of aluminum, magnesium, zinc and various additional metals. After connecting the anode to a DC power supplier, the water close to the wall of the column becomes alkaline (typically, pH values of 9.5 to 10) and acidic close to the anode. As a result, the anode slowly dissolves forming colloids and coagulants of metal salts that envelope and trap the bacteria cells.

The water, with all the colloids and coagulants, flows from the column to the scale treatment cell, which is a modified "Guldager" electrolytic system. It should be noted that this modified "Guldager" electrolytic cell is an essential part of the present invention, but is operated differently as will be discussed later.

The scale treatment cell includes numerous anodes, typically two, made of, or coated with a Ti_2Ni_3 alloy, immersed in a second metallic water tank. These anodes are vertically attached to the cover of the tank, and almost reach the bottom thereof. Contrary to the aluminum anodes of the "Guldager" prior art system, high electrical currents may be connected to these anodes and to the second water tank of the present invention, without damaging the anodes by dissolving them and contaminating the water with metal ions.

After connecting the power supply to the system, the water around the anodes becomes acidic, releasing chlorine from the chloride salts that are

dissolved in the water and free oxygen radicals from the water, while the water close to the cell's walls reach high pH values (typically, 12 to 14). Consequently, the carbonates and aluminum oxides, including the occluded *Legionella Pneumophila* bacteria cells, precipitate on the cathode walls.

The second tank preferably includes a scraper that enables a mechanical cleaning of scale from the inner walls. Typically, the scraper is made of rubber or any other elastomeric material like neoprene, butyl rubber or polybutadiene. The scraper is designed and configured with openings that enable the installment of the anodes, attached to the cover, and also enable free movement of the scraper. After operating the scraper, scale particles are loosened from the inner walls and freely drop to the bottom of the tank. The bottom is equipped with a draining valve for disposing of the loose scale.

For rinsing the water tank after operating the piston and draining loose scale, a rinsing water inlet valve and a rinsing water outlet valve are installed at the upper part of the tank close to the tank cover.

When the thickness of the precipitated salts reach about 0.5 cm, the electrical resistance increases and scale cleaning is necessary. Whenever scale cleaning is desired or needed, the operating water system is closed, the scraper is operated and moved slowly downwards scraping the scale from the inner wall. When the scraper reaches its lowest position, the draining valve is opened and the slurry of loose particles and water is drained out. After draining, the water tank is thoroughly rinsed by opening the water inlet valve

and water outlet valve until clear water comes out. After rinsing the tank, the scraper is raised back to its normal place.

The cleaning process can be operated manually or, preferable, by an automatic, pneumatic or electrical, pre-programmed system according to the electrical resistance or by a timer.

As it will be apparent to those skilled in the art, the cross section cut of the water tank and the piston should not necessarily be round and may also be square or rectangular.

Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims.

WHAT IS CLAIMED IS:

1. A combined electrochemical system for scale treatment and eradicating bacteria in water supply systems comprising:

(a) a first electro-chemical cell including:

(i) a first metallic tank for receiving a water supply, said tank forming a cathode of said first electro-chemical cell, and

(ii) a first anode, disposed within said tank;

(b) a second electro-chemical cell including:

(i) a second metallic tank for receiving an effluent from said first tank, said second tank forming a cathode of said second electro-chemical cell, and

(ii) a second anode, disposed within said second tank; and

(c) a DC electrical supply source operatively connected to said first cell and said second cell,

said first electro-chemical cell operative for trapping bacteria in a colloid-like structure, said second electro-chemical cell operative for producing a pH above 12 near walls of said second tank, so as to form a bacteria-containing precipitate on said walls of said second tank, thereby removing said bacteria from said water supply.

2. The combined electrochemical system of claim 1, wherein said first anode is made of a material selected from the group consisting of aluminum, magnesium, and zinc.

3. The combined electrochemical system of claim 1, wherein said second anode is made of a material selected from the group consisting of an alloy of Ti_2Ni_3 and a metal coated by an alloy of Ti_2Ni_3.

4. The combined electrochemical system of claim 1, wherein said second cell further includes:

(iii) an elastic scraper, said scraper operative for scraping said walls of said second tank, so as to remove said bacteria-containing precipitate from said walls.

5. The combined electrochemical system of claim 1, wherein said bacteria includes *Legionella Pneumophila.*

6. An electrochemical method of scale treatment and eradicating bacteria in water supply systems comprising the steps of:

(a) providing a system including:

(i) a first electro-chemical cell including:

(I) a first metallic tank for receiving a water supply, said tank forming a cathode of said first electro-chemical cell, and

(II) a first anode, disposed within said tank;

(ii) a second electro-chemical cell including:

(I) a second metallic tank for receiving an effluent from said first tank, said second tank forming a cathode of said second electro-chemical cell, and

(II) a second anode, disposed within said second tank;

(b) supplying electrical power to said cells by means of a DC electrical supply source;

(c) trapping bacteria in a colloid-like structure in said first tank, and

(d) precipitating a precipitate in said second tank, said precipitate containing said bacteria.

7. The combined electrochemical method of claim 6, wherein said bacteria is *Legionella Pneumophila.*

Electrochemical System for Scale Treatment & Eradicating Legionella pneumophila Bacteria In Water Supply Systems

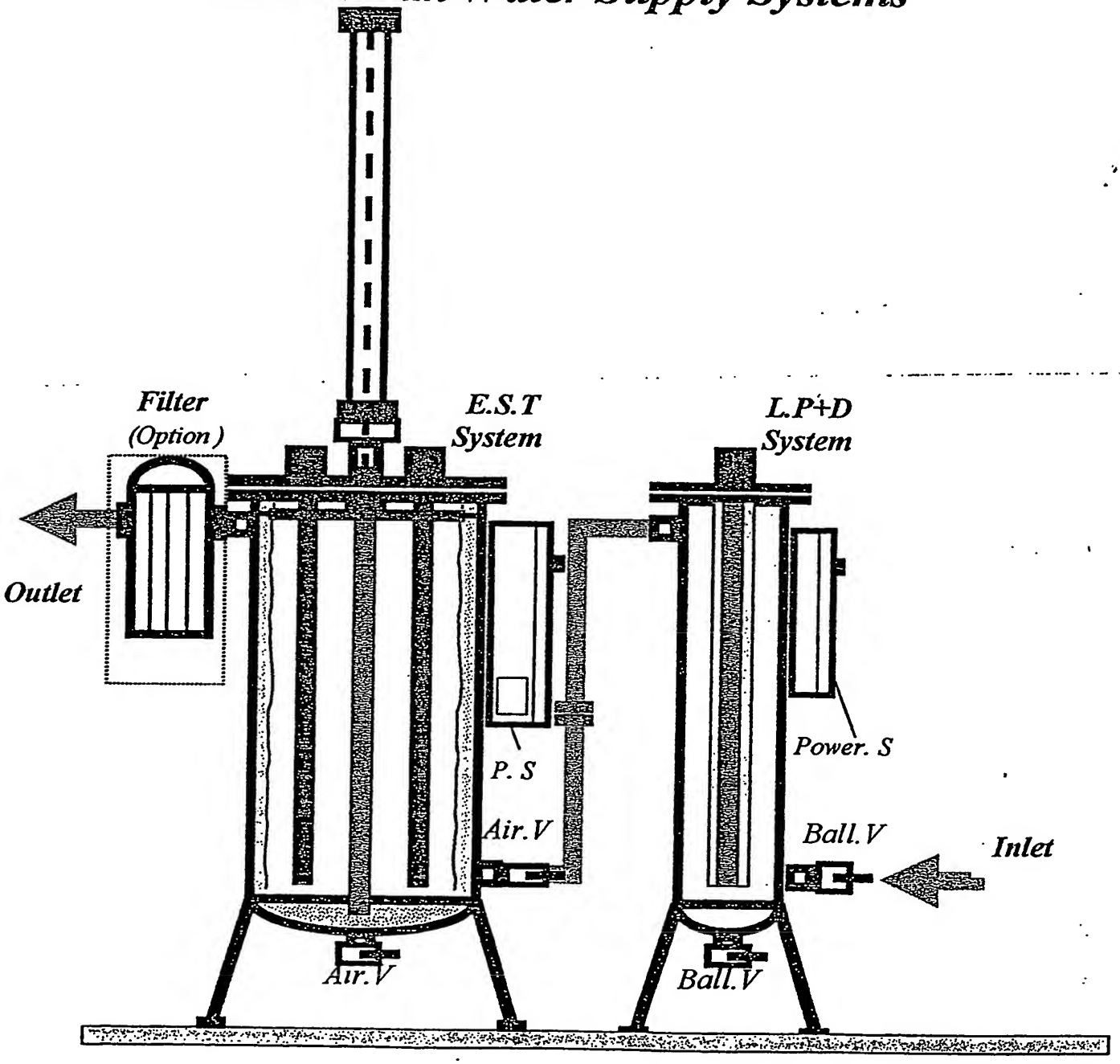

FIG. 1